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# Systematic risk, government policy intervention, and dynamic contrarian investments

Jiapeng Liu, Wenxuan Hou, Qizhi Tao and Ting Zhang<sup>1</sup>

When systematic risk is high, or the market crashes, most risk-averse investors choose to exit the market; however, there are some contrarian investors who opt to make investments. We model such contrarian behaviors by incorporating investors' expectations of government policies into the conventional risk-return trade-off framework. We show that when policy risk is expected to be low and the market has a high probability to recover, subsequent to the government's intervention, the optimal decision for investors is to make investments. On the other hand, when policy risk is high and the market has a high probability to deteriorate, the optimal investment decision is to exit. Our simulation results are consistent with the model predictions.

**Keywords:** Contrarian investments; policy expectations; systematic risk; optimal decisions

**JEL Codes:** G01, G18, G11, C13

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*“Mr. Buffett says he still felt the government had the tools to head off calamity... As the government swung into action, Mr. Buffett recalls, he gained confidence that the crisis would be resolved.”*

— The Wall Street Journal, December 14, 2009

## **1. Introduction**

In the midst of a market crash, most risk-averse investors choose to exit the market; however, there are some contrarian investors who instead opt to make investments. For example, as reported by *The Wall Street Journal*, during the financial crisis of 2008, Warren Buffett looked “into the abyss” in a year of investing dangerously and decided to purchase the stocks of Goldman Aches, General Electric, and Burlington Northern Santa Fe after the government announced a guarantee of assets in money-market funds in September 2008. These deals, according to Warrant Buffett, were based on his faith that the government “would stave off the kind of financial catastrophe.”<sup>2</sup>

When the stock market crashes and systematic risk elevates, investors expect the government to undertake new policies to “save” the market. But whether government intervention, through its visible hands, will succeed is uncertain, resulting in a certain level of policy risk associated with government intervention. As illustrated by the Warren Buffett example, investors appear to make their investment decisions during the financial crisis period based on their expected risk of government intervention policies.

Previous studies have investigated the impact of government political risk or uncertainty on asset prices and risk premium. Pastor and Veronesi (2012) analyze how changes in government policy affect stock prices using a general equilibrium model when there exist uncertainties about government policies and government decisions. One of their model’s predictions is that government policy changes are more likely to occur after “bad” periods, including downturns or periods of unexpectedly low profitability. This prediction is consistent with Alesina et al. (2006) who find evidence that crisis is likely to induce government policy reform. Similar findings are also reported by political economy literature, including Rodrik (1996), Drazen (2000) and

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<sup>2</sup> See “In Year of Investing Dangerously, Buffett Looked 'Into the Abyss'”, by Scott Patterson, *The Wall Street Journal*, December 14, 2009.

Drazen and Easterly (2001). In a same vein, Pastor and Veronesi (2003) models the effect of political uncertainty on risk premia; and their model implies that political risk is associated with increased risk premium, with a larger magnitude in weaker economic conditions. Such a positive relation between the equity premium and political risk has been supported by several empirical studies, including Pantzalis et al. (2000), Li and Born (2006), and Broggaard and Detzel (2012).

In this paper we attempt to explain such risk-seeking behavior of contrarian investors by incorporating exogenous government policy risks into the model. Contrarian investors are those that do not “herd”, or those with “uncommon strategies” (Wei, Wermers, and Yao, 2014). Contrarian investment profit has been attributed to investors’ overreactions to both good and bad news (DeBondt and Thaler, 1985). Lakonishok et al. (1994) show that value strategies produce higher returns because they are contrarian to “naive” strategies followed by other investors. De Haana and Kakesb (2011) report that Dutch institutional investors tend to be contrarian traders, i.e. they buy past losers and sell past winners. Differing from this behavioral finance perspective, our explanation of contrarian investments is derived from a “rational” or traditional finance perspective. A uniqueness of our model is that with the traditional risk-return framework, we extend the two dimensions of risk-return capital asset pricing model (Sharpe, 1964; Lintner, 1965; Mossion, 1966) to three dimensions by incorporating investors’ expectations of government policies when systematic risk is high: a policy-risk-return model.

We show that, in addition to the conventional risk-return trade-off, contrarian investors consider government intervention policy risk when they make investment decisions during a financial crisis. Our model suggests that, when the policy risk is expected to be low and the market has a high probability to become better subsequent to the government intervention, the optimal decision for investors is to make an investment. On the other hand, when the policy risk is high and the market has a high probability to get worse, the optimal investment decision is to exit. Consistent with Lin

and Lin (2014), we show that government policies play an important role in affecting investors' behaviors. Our simulation results are consistent with the model predictions.<sup>3</sup>

## 2. Basic model

### 2.1. Contrarian investment return function

Assuming a certain risk of  $s$  and an expected exogenous policy intervention of  $p$ , we model the function for dynamic contrarian investment return  $m$  as follows:

$$m(s, p) = (1 - p^\alpha) \sqrt{1 - s^2} + bp^\alpha s^\alpha + c \quad (1)$$

where  $b$  is a return adjustment factor:  $b = 1$ ;  $0 < \alpha \leq N$ ;  $\alpha$  is a parameter showing the speed of government policy effect; and  $c$  is a constant.

Note that  $b$  is a return adjustment factor; it shows the effect (including both the direction and the magnitude) of government policy on the market systematic risk. When  $b > 0$ , it indicates government policy has positive (good) effect on the systematic risk; the larger the  $b$ , the bigger the positive effect. That is, the market is getting better. When  $b < 0$ , it indicates government policy has negative (bad) effect on the systematic risk; the larger the  $b$ , the bigger the negative effect. That is, the market is getting worse. In our model, we assume  $b = 1$ , it indicates the effect of government policy on the systematic risk is at a “right” level; and the market systematic is back to its normal level. When the direction of  $b$  is determined, its absolute value affects the magnitude of the government policy effect on the market systematic risk.

Figure below 1 shows a simulated three-dimension dynamic indifference surface for contrarian investment return given various systematic risk expectations based on Eq. (1).<sup>4</sup> The figure is a collection of numerous indifference curves across a continuous-time stochastic process during a certain time period, with each curve representing a trade-off between expected contrarian investment return  $m$  and a certain level of risk  $s$ . The value of  $p$  in the figure indicates the extent to which exogenous policy

<sup>3</sup> Similarly, Zhou (2013) models the impacts of the confidence on market equilibrium and shows that a contrarian trading pattern arises due to the insider's overconfidence. Vo (2008) shows that early-informed investors may behave like contrarians.

<sup>4</sup> According to the Modern Portfolio Theory and Capital Asset Pricing Model, only systematic risk matters in pricing capital assets while firm-specific or non-systematic risk can be diversified away in a well-diversified portfolio.

intervention affects the systematic risk. The curve (A–A) in Figure 2a depicts contrarian investors' Tobin risk-seeking preference at the beginning of the period, when a systematic risk is high (or a financial crisis occurs). At the end of the period, when the systematic risk reduces to a normal level, the B–B curve (Figure 2b) depicts contrarian investors' Markowitz risk aversion. The figures shows that, as the effects of exogenous policy intervention on the systematic risk increase, the risk feature for contrarian investors will change as well; that is, they will gradually become risk-averse, transitioning from being originally risk-seeking based on their expected trade-off between investment return and systematic risk levels.

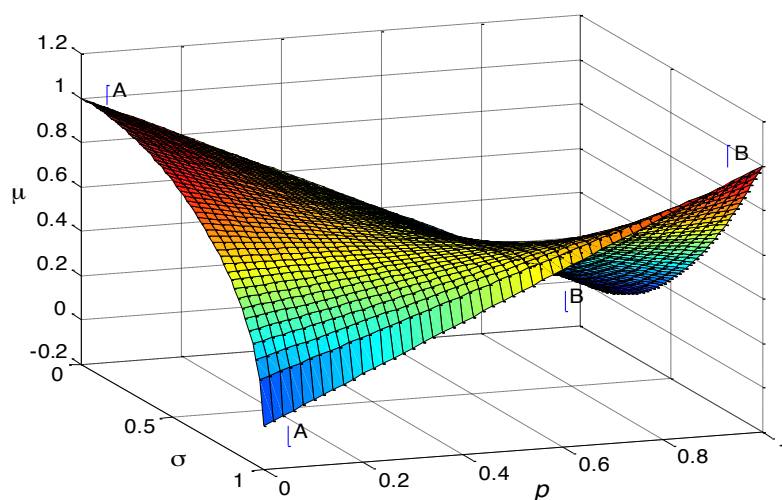


Figure 1: Three-dimension of risk, return and policy

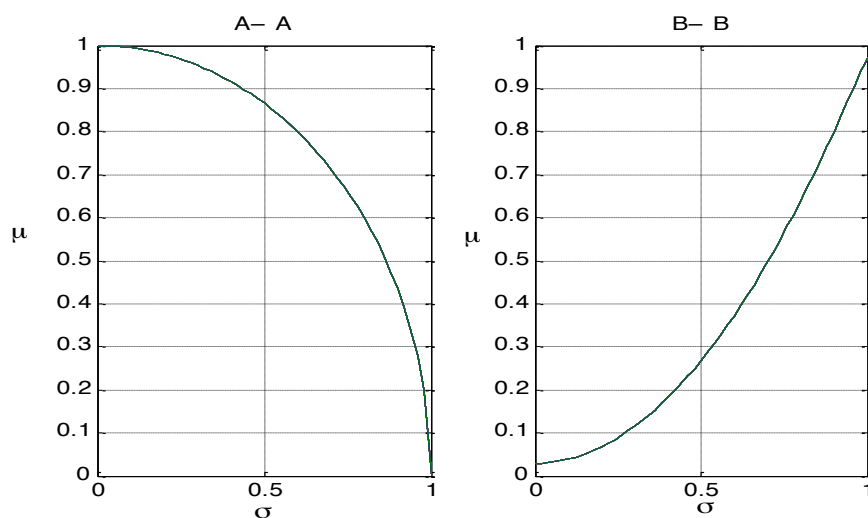


Figure 2a: A cutoff view for the starting point

Figure 2b: A cutoff view for the ending point

## 2.2 Optimizing dynamic contrarian investment return

Under the traditional capital market pricing model, the market constraint is the capital market line, which is formulated based on two dimensions: expected return and risk. We introduce the parameter  $p$ , or the expected exogenous policy intervention, into the CAPM and make it a three-dimensional model as follows:

$$m(s, p) = E(r) = r_f(p) + s \frac{r_m(p) - r_f(p)}{s_m(p)} = r_f(p) + l(p)s \quad (2)$$

$$\text{where } l(p) = \frac{r_m(p) - r_f(p)}{s_m(p)}$$

Figure 3 below shows the capital market surface, consisting of numerous continuously changing capital market lines in a three-dimensional representation. The capital market surface is tangent with the return surface.

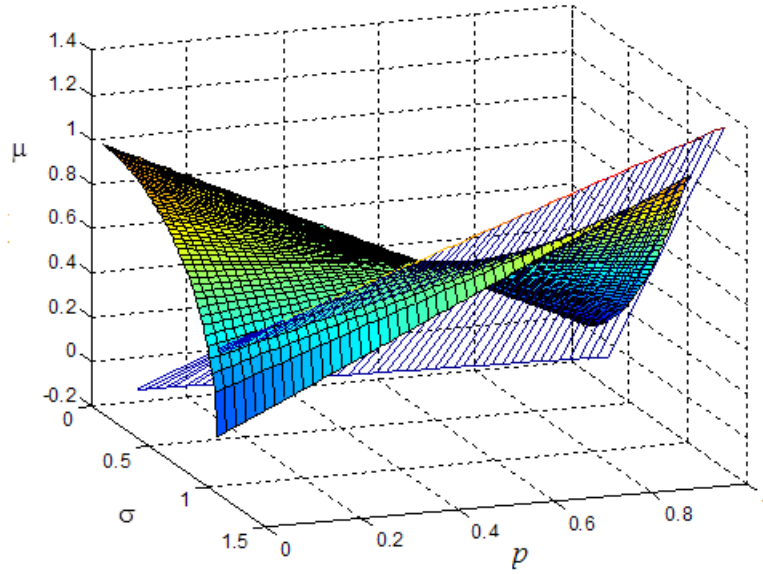


Figure 3: Capital market surface

The utility function for contrarian investors is defined as follows:

$$U = U(s, m, p) \quad (3)$$

$$= g(m - (1 - p^a)\sqrt{1 - s^2} - bp^a s^n + c)$$

where the first derivate for  $g(\cdot)$  is increasing; that is,  $g'(\cdot) > 0$

Without losing generality, we have:

$$U(s, m, p) = m - (1 - p^a) \sqrt{1 - s^2} - bp^a s^n + c \quad (3a)$$

In addition to the traditional risk-return trade-off, contrarian investors will consider the effect of policy intervention on the systematic risk changes. Therefore, our maximization function becomes:

$$\max_{s, m, p} : U = U(s, m, p) \quad (4)$$

$$s.t. : m = r_f + l(p) \forall s$$

$$\text{where } l(p) = \frac{r_m(p) - r_f}{s_m(p)}$$

$$U(s, m, p) = m - (1 - p^a) \sqrt{1 - s^2} - bp^a s^n + c \quad (5)$$

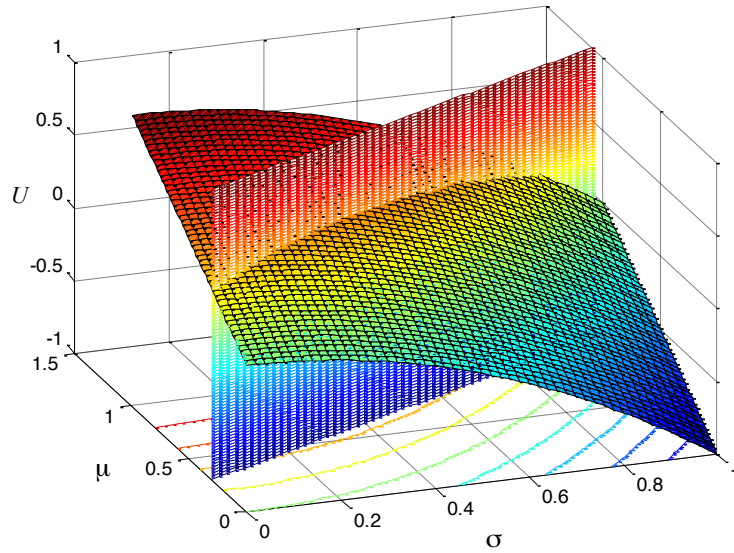


Figure 4: Contrarian investment decision utility space

In Figure 4, shown above, the surface is the investors' utility function, the plane is the capital market constraint, and the cluster of curves on the bottom refers to investors' risk-return indifference curves. The figure indicates there is a maximum value in the intersection of the components, and it is located at the tangent plane between the capital market plane and investors' risk-return indifference curves.

To solve for Eq. (4), we have

$$\begin{aligned} m &= (1 - p^a) \sqrt{1 - s^2} + bp^a s^n + c \\ m &= r_f + l(p) \forall s \end{aligned} \quad (6)$$



when  $p = 1$ ,  $n = 2$ , there exists a solution.

$$(1 - p^a)\sqrt{1 - s^2} + bp^as^n + c = r_f(p) + l(p)s \quad (7)$$

when  $p = 1$ ,  $n = 2$ ,

$$bs^2 + c = r_f + l s \quad (8)$$

We then have:

$$bs^2 - l s + c - r_f = 0 \quad (9)$$

Because

$$b(s - \frac{l}{2b})^2 + c - r_f - (\frac{l}{2b})^2 = 0 \quad (10)$$

when  $c = r_f + (\frac{l}{2b})^2$  we obtain the sole solution as follows:

$$\begin{aligned} s &= \frac{l}{2b} \\ m &= r_f + \frac{l^2}{2b} \end{aligned} \quad (11)$$

Therefore the optimal point is located at:  $\frac{l}{2b}, r_f + \frac{l^2}{2b}$ . The optimal point in an

empirical setting represents an optimal investment which has a risk of  $s = \frac{l}{2b}$  with the utility of  $m = r_f + \frac{l^2}{2b}$ . The risk of this optimal investment has a positive relation with  $l$  and a negative relation with  $b$ , whereas  $l$  is one unit of risk premium,  $b$  is a return adjustment factor.

### 3. Model extension

#### 3.1. Considering the uncertainty of systematic risk with policy intervention

In this section we extend the previous model by considering the uncertainty associated with the systematic risk change, which arises as a result of the uncertainty associated with the policy intervention outcome. In our one period model, we assume that, with the exogenous policy intervention, the market has a probability of  $q$  to become better and a probability of  $1-q$  to become worse. Our investment return function is:

$$\mu(\sigma, p) = (1 - p^\alpha) \sqrt{1 - \sigma^2} + b B p^\alpha \sigma^n \quad (12)$$

where  $b$  is return adjustment factor, and  $B$  is a random factor following normal distribution,  $B \sim B(1, q)$ :

$$\begin{cases} \text{prob}(B = 1) = q \\ \text{prob}(B = -1) = 1 - q \end{cases}$$

The effects of policy uncertainty on the risk-return trade-off are shown in Figure 5 below. In reality, there are several types of “uncertainties” related with the government policy, including whether the government will introduce new policy, the timing, and the effect of such a policy. In our model, we consider the effects of government policy on the market systematic risk.

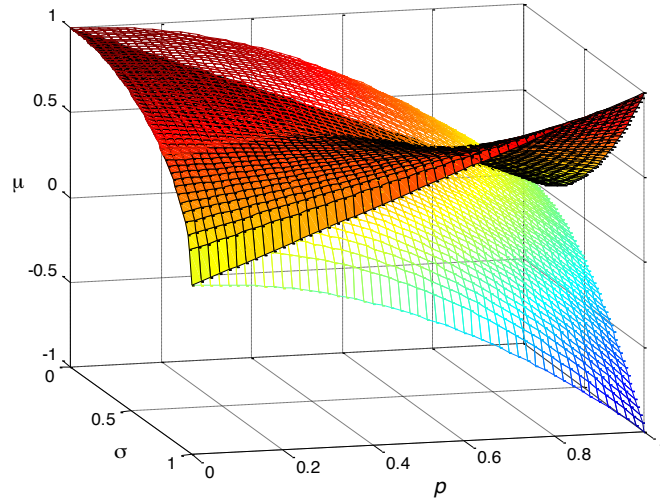


Figure 5: The effect of policy uncertainty on the risk-return trade-off

$B$  is a random factor in the above equation; its expected return is obtained as:

$$E(\mu(\sigma, p)) = (1 - p^\alpha) \sqrt{1 - \sigma^2} + b(2q - 1) p^\alpha \sigma^n \quad (13)$$

Thus the expected value  $E(\mu(\sigma, p))$  is a function of  $q$ , risk  $\sigma$ , and policy  $p$ .

When  $p = 1$ ,

$$E(\mu(\sigma, 1)) = b(2q - 1) \sigma^n \quad (14)$$

$q$  is the probability that the market become better. When  $q = 0.5$ ,

$$E(\mu(\sigma, 1)) = 0 \quad (15)$$

Figure 6 shows the contrarian investment expected return. The upward tilted surface indicates the return when the market becomes better, or when  $q = 1$ . The downward tilted surface indicates the return when the market worsens, or when  $q = 0$ . The surface in the middle shows the expected investment return when  $q = 0.5$ .

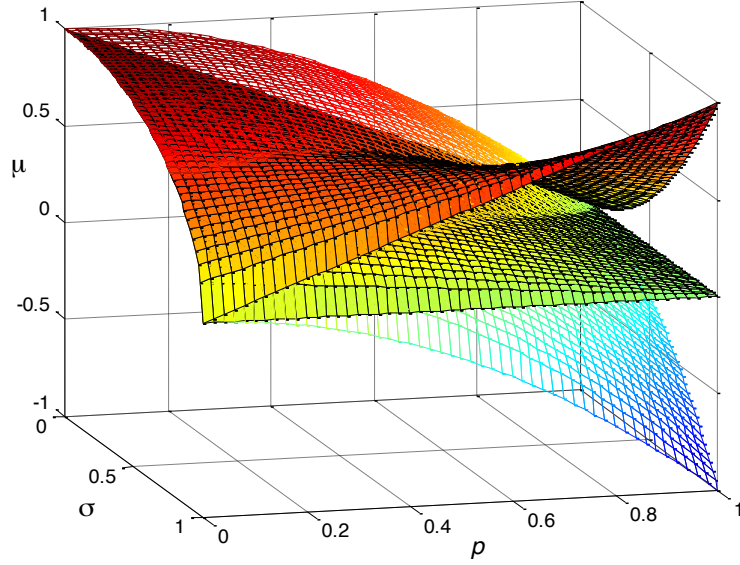


Figure 6: The contrarian investment expected return

### 3.2 Optimizing dynamic contrarian investment return with uncertainty associated with policy intervention

The expected utility with uncertainty associated with policy intervention is shown as follows:

$$E(U(s, m, p)) = m - (1 - p^a) \sqrt{1 - s^2} - b(2q - 1)p^a s^n + c \quad (16)$$

The optimal decision becomes:

$$\max_{\mu, \sigma} : E[U(\mu, \sigma)] = \mu - (1 - p^a) \sqrt{1 - \sigma^2} - b(2q - 1)p^a \sigma^n + c \quad (17)$$

$$s.t. : r = r_f + \lambda(p) \times \sigma$$

where  $\lambda(p) = \frac{r_m(p) - r_f}{\sigma_m(p)}$

Using the Lagrange multiplier we have:

$$\begin{aligned} L &= U(s, m, p) - l(m - r_f - l(p) \forall s) \\ &= m - (1 - p^a) \sqrt{1 - s^2} - b(2q - 1)p^a s^n + c - l(m - r_f - l(p) \forall s) \end{aligned} \quad (18)$$

When  $p = 1$  the above equation becomes:<sup>5</sup>

$$L = m - b(2q - 1)s^n + c - l(m - r_f - l(p) \forall s) \quad (19)$$

The first order condition is:

$$\begin{aligned} \frac{\partial L}{\partial s} &= -b(2q - 1)ns^{n-1} + ll = 0 \\ \frac{\partial L}{\partial m} &= 1 - l = 0 \\ \frac{\partial L}{\partial l} &= -(m - r_f - l \forall s) = 0 \end{aligned} \quad (20)$$

We obtain the solution as:

$$\begin{aligned} l &= 1 \\ s &= \left( \frac{l}{nb(2q - 1)} \right)^{\frac{1}{n-1}} \\ m &= r_f + l \forall \left( \frac{l}{nb(2q - 1)} \right)^{\frac{1}{n-1}} \end{aligned} \quad (21)$$

Thus, the optimal point is located at:  $\left( \left( \frac{\lambda}{nb(2q - 1)} \right)^{\frac{1}{n-1}}, r_f + \lambda \left( \frac{\lambda}{nb(2q - 1)} \right)^{\frac{1}{n-1}} \right)$ . Relative to

previous solution of  $\frac{\hat{l}}{2b}, r_f + \frac{l^2}{2b}$ , the difference is the consideration of  $(2q - 1)$ . At this

point it will change in an opposite direction with  $nb(2q - 1)$ . Note that  $q$  is the probability that government policy will have a better effect.

When  $n=2$ , the optimal point is located at:  $\left( \frac{\lambda}{2b(2q - 1)}, r_f + \frac{\lambda^2}{2b(2q - 1)} \right)$ . When  $q$

$< 0.5$ ,  $\frac{\lambda}{b(2q - 1)} < 0$ , does not make sense; that is, when the policy is more likely to

<sup>5</sup> When  $p = 1$ , the government policy has the largest intervention effect; when  $p = 0$ , government has no policy intervention.

become worse, the optimal decision is not to make an investment, or exit the market.

#### 4. Simulation

We built a discrete model to simulate the above results. We assume that the government introduces the intervention policies in different phases, and the market will adjust its expectations accordingly. The policies could make the market better; but they could also make the market get worse.

We build discrete binomial model with  $n$  period:

$$\mu(\sigma, p) = (1 - p^\alpha)\sqrt{1 - \sigma^2} + \sum_{i=1}^n B_i b p^\alpha \sigma^n / n \quad (22)$$

where  $B_i$  is a binomial random variable,  $B \sim B(1, q)$ , it is equal to 1 or  $-1$ .

$$\begin{cases} \text{prob}(B_i = 1) = q \\ \text{prob}(B_i = -1) = 1 - q \end{cases} \quad (23)$$

To begin with, we use different values of  $q$  to represent investors' different expectations of the effects of government policy on the market systematic risk, based on which investors change their investment decisions. We then estimate investors' returns conditional on different values of  $q$  and determine the optimal portfolio that will generate the largest investment return. Figure 7 shows the multi-period expected return volatility when  $q = 0.8$ . With the policy intervention, the investment returns could be good or bad, with a probability of  $q$  to become good. Figure 8 indicates one path of the investment return change, whereas Figure 9 shows different paths – thin lines shows the specific simulation path and thick line shows the expected paths. The figure indicates a reverse of investment returns with the policy intervention.

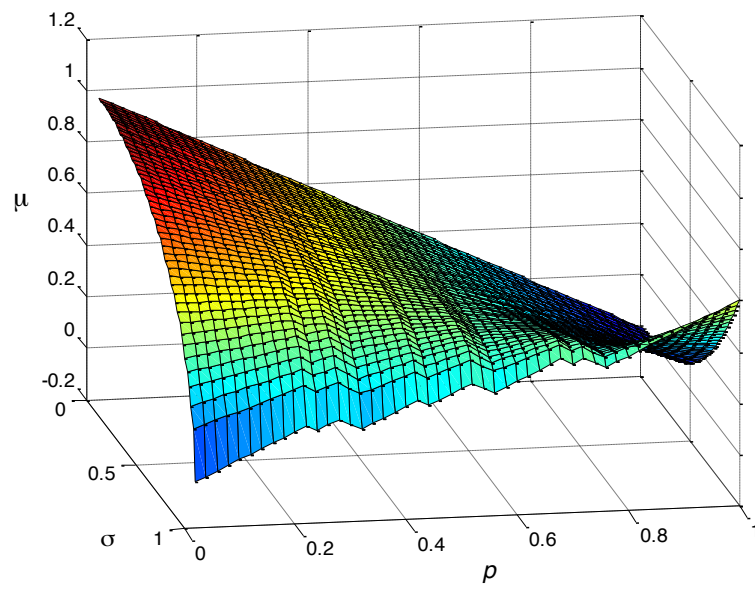


Figure 7: Contrarian investment expected return with a multi-period policy intervention

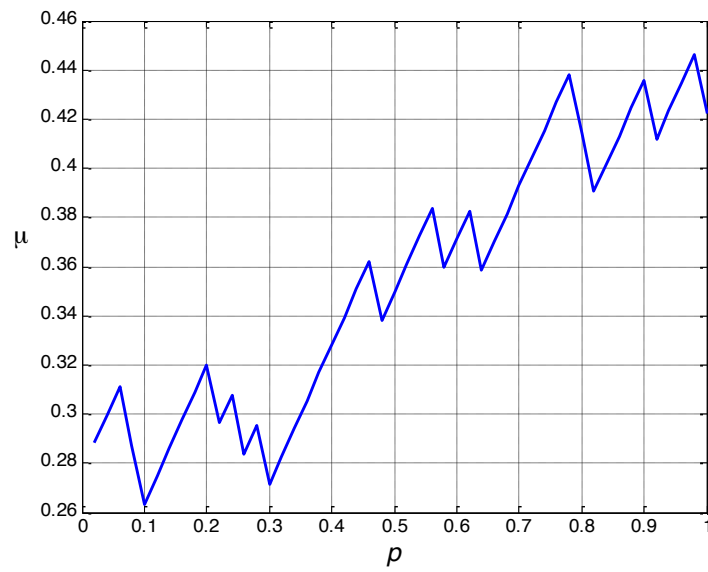


Figure 8: One simulated path of the investment return change

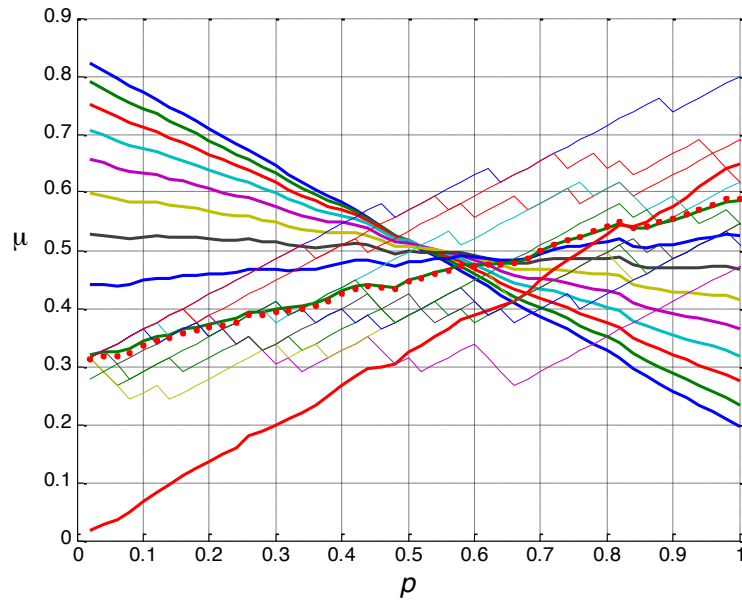


Figure 9: Multiple simulated paths of the investment return change

Figure 10 shows the simulated optimal portfolio investment return when  $q = 0.85$ . The blue line represents the expected utility using binomial simulation, the red line represents the optimal value based on our model calculation, and the green line shows the path for the optimal value. These figures show that our theoretical optimal value is consistent with our simulated results, providing further support to our model.

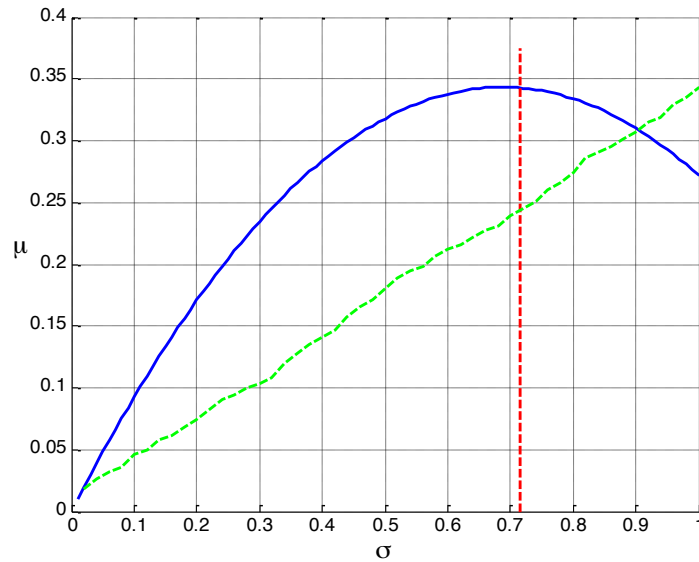


Figure 10: Simulated optimal portfolio investment return when  $q = 0.85$

The recent changes of Chinese Stock Market and the Chinese government reactions

can be a good illustration of our theoretical model. The Chinese Stock Market has lost more than 30% of its value over a three-week period by July 9, 2015, with 1,400 companies (more than half listed on Shanghai Stock Exchange) filed for a trading halt to avoid further stock crash. The Chinese government has enforced a few policies to prevent market crash, including (1) putting a limitation or prohibiting short sell; (2) providing cash to brokers to buy shares; (3) stopping IPO (initial public offerings); (4) imposing a six-month ban on stockholders with more than 5% of a company's shares from selling their stocks; and (5) cutting the interest rate. Note that the Chinese Stock Market is notably different from other developed markets. It is highly speculative and dominated by retail investors. A majority of Chinese investors are skeptical whether these policies will be effective, when considering the uncertainty associated with these policies, as well as the overall Chinese economic condition. Therefore, the optimal investment decision for Chinese investors is to exit the market. In fact, after a modest rebound in early July, the stock market fell again on 27 July, with a largest single-day loss of 8.5 percent since 2007. As of the end of September of 2015, the stock market is still about 34% off from its peak in mid-June.<sup>6</sup>

## 5. Conclusions

We propose a model to explain contrarian investors' investment decisions by considering their expectations on the exogenous government policy risk. When the stock market crashes and systematic risk becomes high, investors expect the government to undertake new policies to "save" the market. But whether government intervention will succeed is uncertain, resulting in a certain level of policy risk. We show that when the policy risk is expected to be low and the market has a high probability to become better subsequent to the government intervention, the optimal decision for investors is to make an investment. On the other hand, when the policy risk

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<sup>6</sup> It is generally believed that the "visible hands" of a government is not good to a well-developed or efficient market. However, when the market crashes and the investors become overly panic (irrational), the government intervention is helpful. One example is the US government intervention during the recent financial crisis. The policy changes from the government will affect investors' expectation about the market risk and return trade-off, thus affecting their investment decisions.



is high and the market has a high probability to get worse, the optimal investment decision is to exit. Using simulation we provide strong support of our model predictions.

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